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Dynamical Shannon entropy and information Tsallis entropy in complex systems

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Abstract

In this work, we offer a new approach to the concept of the information entropy for the description of the dynamic behaviour of complex systems. On the basis of the unification of the known information approach to the Shannon entropy, submitted in works of authors [Phys. Rev. E 62 (5) (2000) 6178; Physica A 303 (2002) 427], and generalization of the Boltzman–Gibbs entropy, offered by Tsallis [Braz. J. Phys. 29 (1) (1999) 1], we have received a new representation of the dynamic information entropy. Here we present concrete applications of the received equations to the study of complex systems related to the electric signals of ECGs of healthy people and patients with myocardial infarction (MI) as an example. Various modifications of the non-Markovity parameter are also submitted. They were received with the help of the new approach to the information entropy. We have received detailed information about Markov, quasi-Markov and non-Markov characteristics of the RR-interval fluctuations of the ECGs with the help of the chain of Zwanzig'-Mori's discrete kinetic equations and dynamical Tsallis entropy.

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Keywords: Dynamical Shannon' and Tsallis's entropy; Kinetic theory; Stochastic processes; Non-Markovity parameter

1. Introduction

In recent years the interest in the study of complex systems of wildlife has steadily grown. However, the standard methods of theoretical physics have proved

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